Do interventions that improve immunisation uptake also reduce social inequalities in uptake?

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Abstract

***Objective*—To investigate whether an intervention designed to improve overall immunisation uptake affected social inequalities in uptake.**

***Design*—Cross-sectional small area analyses measuring immunisation uptake in cohorts of children before and after intervention. Small areas classified into five groups, from most deprived to most affluent, with Townsend deprivation score of census enumeration districts.**

***Setting*—County of Northumberland.**

***Subjects*—All children born in county in four birth cohorts (1981-2, 1985-6, 1987-8, and 1990-1) and still resident at time of analysis.**

***Main outcome measures*—Overall uptake in each cohort of pertussis, diphtheria, and measles immunisation, difference in uptake between most deprived and most affluent areas, and odds ratio of uptake between deprived and affluent areas.**

***Results*—Coverage for pertussis immunisation rose from 53·4% in first cohort to 91·1% in final cohort. Coverage in the most deprived areas was lower than in the most affluent areas by 4·7%, 8·7%, 10·2%, and 7·0% respectively in successive cohorts, corresponding to an increase in odds ratio of uptake between deprived and affluent areas from 1·2 to 1·6 to 1·9 to 2·3. Coverage for diphtheria immunisation rose from 70·0% to 93·8%; differences between deprived and affluent areas changed from 8·6% to 8·3% to 9·0% to 5·5%, corresponding to odds ratios of 1·5, 2·0, 2·5, and 2·6. Coverage for measles immunisation rose from 52·5% to 91·4%; differences between deprived and affluent areas changed from 9·1% to 5·7% to 8·2% to 3·6%, corresponding to odds ratios of 1·4, 1·4, 1·7, and 1·5.**

***Conclusion*—Despite substantial increase in immunisation uptake, inequalities between deprived and affluent areas persisted or became wider. Any reduction in inequality occurred only after uptake in affluent areas approached 95%. Interventions that improve overall uptake of preventive measures are unlikely to reduce social inequalities in uptake.**

Introduction

Routine immunisation of infants is effective and benefits the health of immunised children and communities where coverage is high.[1,2] Every effort should therefore be made to ensure that uptake is as high as possible and equal across social groups. Any social inequity in uptake will exacerbate the social inequalities in health that already exist. A common view is that improving overall uptake of any preventive activity will also tend to reduce social inequalities in uptake because the groups with the poorest uptake are likely to improve the most. However, improvements in the delivery of services that are applied indiscriminately across the population may leave inequalities unchanged or actually widen them because poorer members of society have less opportunity to take advantage of available services.[3-5]

We had an opportunity to examine what happens to social inequalities in uptake of immunisation after an intervention to improve overall uptake in Northumberland, a health district in the area administered by Northern Regional Health Authority. In the early 1980s immunisation coverage in Northumberland was among the poorest in the region. In 1984 a concerted and sustained effort was made to improve immunisation by feeding back named information on non-immunised children to general practitioners and health visitors, distributing clear advice on immunisation to primary care services, and providing an immunisation referral service. This resulted in immunisation coverage increasing over the next three years to among the highest in the region. Although there were concurrent improvements in immunisation coverage regionally and nationally, particularly for pertussis immunisation, the increase in Northumberland shortly after the intervention was more rapid than elsewhere.[6,7]

Methods

Social inequalities in immunisation uptake were measured by assigning cases to their enumeration district of residence, which were then ranked by the Townsend material deprivation index.[8] Differences in uptake between deprived and affluent areas could then be measured in cohorts of children who received their immunisations before and after the intervention.

IMMUNISATION DATA

Immunisation data were extracted from the information systems of child health in Northumberland on four cohorts of children born in the district and still resident there: those born in 1981-2, 1985-6, 1987-8, and 1990-1. The first cohort of children should have been immunised before the intervention began in 1984, while the others would have been exposed to the intervention. Information on the first three cohorts was drawn in October 1990 as part of a larger study,[9] and data on the last cohort were drawn in February 1993.

Coverage for pertussis immunisation was measured in the first three cohorts as the proportion of children fully immunised (three pertussis immunisations) by the age of 15 months. In 1990 the immunisation schedule for pertussis, diphtheria, tetanus, and polio changed to the accelerated schedule at eight, 12, and 16 weeks, so coverage for pertussis immunisation was measured in the final cohort as the proportion of children fully immunised by 10 months and births in 1989 were omitted to avoid complicating the analysis. Previous work in the district had shown that immunisation coverage at 10 months with the accelerated schedule was similar to coverage at 15 months with the old schedule. Coverage of diphtheria immunisation was measured similarly.

Coverage for measles immunisation was measured as

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the proportion of children immunised by either single antigen measles immunisation or combined measles, mumps, and rubella immunisation by 19 months of age. In the final cohort only cases born before July 1991 were included, as those born later would not have reached 19 months by the time the data were analysed. This accounts for the reduced number in this cohort.

GEOGRAPHIC DATA

The methods of collecting geographic data have been described elsewhere.[9 10] Briefly, each child's postcode was assigned to the census enumeration district of residence by matching the Ordnance Survey grid reference of the postcode to the nearest grid reference of an enumeration district "centroid."[10 11] Previous work has shown the postcodes of addresses to be accurate in 97% of cases, and 93% of cases with postcodes could be assigned to an enumeration district, although the accuracy of matching was lower.[10] However, these inaccuracies affected all cohorts and geographic areas equally. The Townsend material deprivation index[8] was calculated for each enumeration district and consisted of the sum of the individual z scores derived from four census variables: the proportion of economically active adults who were unemployed, the proportion of households without the use of a car, the proportion of households with more than one person per room, and the proportion of households not owner occupied. Enumeration districts were divided into five groups containing roughly similar proportions of the population on the basis of the Townsend index from the most deprived group of districts (group 1) to the most affluent group (group 5). The enumeration districts were classified in the same way throughout the study using data from the 1981 census.

STATISTICAL ANALYSIS

Social inequalities in coverage are shown in three ways: as the χ^2 value for trend to indicate how much of the variability between deprivation groups was accounted for by a linear socioeconomic gradient; as the difference in coverage between the most deprived and most affluent areas; and as the odds ratio of being immunised between deprived and affluent groups. There is debate about the most appropriate way of measuring inequality,[12] and interpretation of our results changes slightly depending on which index of inequality is used. However, the actual data illustrate our points most clearly.

TABLE I—*Uptake of pertussis immunisation in different deprivation groups before (cohort 1981-2) and after (cohorts 1985 onwards) intervention to improve overall uptake. Values are percentages (numbers) unless stated otherwise*

	Birth cohorts			
Deprivation groups	1981-2	1985-6	1987-8	1990-1
1 (most deprived)	49·2 (699/1420)	71·9 (962/1338)	75·2 (1031/1371)	86·8 (1304/1503)
2	54·0 (752/1392)	76·9 (976/1270)	80·5 (989/1229)	91·0 (1139/1252)
3	54·8 (812/1482)	82·8 (1002/1210)	84·2 (1057/1255)	93·0 (1187/1276)
4	55·7 (665/1193)	80·6 (762/945)	85·4 (826/967)	92·6 (915/988)
5 (most affluent)	53·8 (749/1393)	80·6 (821/1018)	85·4 (891/1043)	93·8 (966/1030)
Total	53·4 (3677/6880)	78·2 (4523/5781)	81·7 (4794/5865)	91·1 (5511/6049)
χ^2 test for trend (P value, df=1)	6·4 (<0·05)	34·3 (<0·001)	54·1 (<0·001)	41·7 (<0·001)
Difference between most affluent and deprived (group 5 - group 1)	4·6	8·7	10·2	7·0
Odds ratio (95% confidence interval) of uptake between group 1 and group 5	1·2 (1·0 to 1·4)	1·6 (1·3 to 2·0)	1·9 (1·6 to 2·4)	2·3 (1·7 to 3·1)

TABLE II—*Uptake of diphtheria immunisation in different deprivation groups before (cohort 1981-2) and after (cohorts 1985 onwards) intervention to improve overall uptake. Values are percentages (numbers) unless stated otherwise*

	Birth cohorts			
Deprivation groups	1981-2	1985-6	1987-8	1990-1
1 (most deprived)	64·0 (907/1417)	82·1 (1099/1338)	84·0 (1151/1370)	90·6 (1362/1503)
2	70·0 (974/1391)	87·4 (1110/1270)	88·7 (1088/1227)	93·8 (1173/1251)
3	71·9 (1064/1479)	91·3 (1105/1210)	92·5 (1161/1255)	95·1 (1213/1276)
4	71·4 (851/1192)	89·6 (847/945)	91·9 (889/967)	94·9 (938/988)
5 (most affluent)	72·6 (1011/1393)	90·4 (919/1017)	93·0 (970/1043)	96·1 (990/1030)
Total	70·0 (4807/6872)	87·9 (5080/5780)	89·7 (5259/5862)	93·8 (5676/6048)
χ^2 test for trend (P value, df=1)	22·9 (<0·001)	42·2 (<0·001)	62·1 (<0·001)	34·6 (<0·001)
Difference between most affluent and deprived (group 5 - group 1)	8·6	8·3	9·0	5·5
Odds ratio (95% confidence interval) of uptake between group 1 and group 5)	1·5 (1·3 to 1·8)	2·0 (1·6 to 2·6)	2·5 (1·9 to 3·3)	2·6 (1·8 to 3·7)

TABLE III—*Uptake of measles immunisation in different deprivation groups before (cohort 1981-2) and after (cohorts 1985 onwards) intervention to improve overall uptake. Values are percentages (numbers) unless stated otherwise*

	Birth cohorts			
Deprivation groups	1981-2	1985-6	1987-8	1990-1*
1 (most deprived)	47·4 (669/1410)	71·6 (960/1340)	77·0 (1057/1373)	88·8 (936/1054)
2	51·2 (711/1389)	74·4 (947/1272)	81·8 (1008/1232)	91·2 (799/876)
3	55·3 (816/1476)	78·7 (953/1211)	86·6 (1089/1258)	92·0 (825/897)
4	52·2 (621/1190)	77·9 (737/946)	84·1 (818/973)	94·2 (632/671)
5 (most affluent)	56·5 (781/1383)	77·3 (789/1021)	85·2 (890/1045)	92·4 (679/735)
Total	52·5 (3598/6848)	75·8 (4386/5790)	82·7 (4862/5881)	91·4 (3871/4233)
χ^2 test for trend (P value, df=1)	20·8 (<0·001)	15·0 (<0·001)	32·1 (<0·001)	12·1 (<0·001)
Difference between most affluent and deprived (group 5 - group 1)	9·1	5·7	8·2	3·6
Odds ratio (95% confidence interval) of uptake between group 1 and group 5	1·4 (1·2 to 1·7)	1·4 (1·1 to 1·6)	1·7 (1·4 to 2·1)	1·5 (1·1 to 2·1)

*Only until June 1991 (see methods for details).

Results

Table I shows that the overall uptake for pertussis immunisation rose from 53% in the first cohort to 78% in the cohort immediately after the intervention started and then to 82% and finally to 91%. Although the most recent figures were similar to those found in many other districts with high coverage, the rate of increase of uptake was greater than elsewhere because of the poor early figures. This shows that the local intervention to improve overall uptake was successful.[6 7] A similar increase in uptake was seen with immunisation for diphtheria (table II) and measles (table III).

Differences between deprived and affluent areas, however, persisted. The most deprived areas (group 1) always had the poorest uptake followed by group 2. Uptake in the most affluent areas was not always highest, and in some cases uptake in group 3 was higher. Nevertheless, uptake in the most affluent areas usually approached that in the best overall group.

The differences in uptake between deprived and affluent areas narrowed only slightly despite the dramatic overall improvement in uptake. For pertussis immunisation the initial difference between deprived and affluent areas was 4·6%. This increased to 8·7% and then to 10·2% and finally reduced to 7·0%. For diphtheria immunisation the difference between the most deprived and most affluent areas changed from 8·6% before the intervention to 8·3%, 9·0%, and finally 5·5%. For measles immunisation the difference changed from 9·1% to 5·7%, 8·2%, and 3·6%.

For each of the immunisations, reduction in the difference in uptake between deprived and affluent areas occurred only after the overall uptake had risen above 90%, and the only immunisation for which this reduction was substantial was for measles. However, the absolute difference between rates is not the best means of measuring inequalities. For one thing it is bound to reduce as overall uptake approaches 100%. A more appropriate measure is the odds ratio of uptake, which compares the odds of being immunised in an affluent area with the odds of being immunised in a deprived area. This shows that inequalities in uptake steadily widened throughout the study for pertussis and diphtheria immunisation, even in the final cohort, and remained steady for measles. In the final cohort the odds of a child being immunised against pertussis and diphtheria were over twice as great in the most affluent areas as they were in the most deprived areas, while for measles immunisation the odds were 1·5 times as good, the same as before the start of the intervention.

Discussion

A concerted and sustained intervention to improve uptake of childhood immunisation contributed to a dramatic increase in overall uptake across a health district, but the difference in uptake between deprived and affluent areas hardly altered until the overall uptake exceeded 90%, when there was as modest reduction in the difference between deprived and affluent areas for pertussis and diphtheria immunisation and a greater reduction for measles immunisation. The odds ratios of uptake showed that inequalities steadily widened even after the overall uptake had exceeded 90% for pertussis and diphtheria immunisation and remained the same for measles immunisation. These results suggest that, at best, social inequalities start to narrow only when little further improvement in the uptake of the more affluent groups is possible.

METHODOLOGICAL PROBLEMS

The retrospective data from the earliest cohort may have been less accurate than the later data. Inaccuracies from moves in and out of the district should not have affected the results because only children who were born and remained resident in the district were included. Some children might have moved internally, but it is likely that the addresses we recorded were those at which the child was resident when it was immunised; in any case most moves would have been to and from similar types of neighbourhood so that the deprivation classification should not have changed. In order to have underestimated the true extent of inequalities in uptake in the earliest cohort, inaccuracies would have needed to have been proportionately greater in the affluent group than in the deprived group because data inaccuracy tends to underestimate uptake. Evidence from other studies suggests that it is in deprived areas that inaccuracies in immunisation data are more of a problem,[13 14] strengthening the conclusions of our study.

The long delay between immunisation of the first cohort and analysis of the data also raises the possibility that emigration from the district might have affected the results. If emigrants were more likely to have been immunised than non-migrants and principally came from the more affluent areas then the width of inequalities in the first cohort might have been underestimated. Data from population tables for the early 1980s suggests that the proportion of children aged under 5 years who emigrated each year was about 3%.[15] We have no means of knowing how much this interfered with our analysis, but none of the methodological problems are likely to have underestimated the difference between deprived and affluent areas by enough to have altered the overall conclusions.

IMPLICATIONS OF RESULTS

We studied immunisation uptake only, but our findings may apply to other preventive activities in the health service. The results tend to confirm the view that any improvement or increase in the level of services that is applied across a population and that results in a general improvement in health will not necessarily reduce social inequalities in health and may widen them.[3-5] This point has been discussed with respect to prevention of childhood accidents, cervical cancer, coronary heart disease, other smoking related disease, and teenage pregnancy,[16 17] all of which show wide social differences. Instituting population based prevention programmes against these problems may not reduce social inequalities in them.

This does not mean that social inequalities in the uptake of preventive activities cannot be changed.[17] Marsh and Channing showed that prioritising services to a deprived estate in their primary health care practice resulted in the virtual abolition of social inequalities in a range of preventive activities.[18] The important differences between that study and ours is that their primary aim was the reduction of social inequalities in coverage rather than an improvement in overall levels of coverage. It appears that we cannot rely on a general improvement in the efficiency of delivery of a service to narrow any inequalities in uptake; we have to direct specific measures towards improving social equity in uptake as well. This in turn has resource implications. The health service and ultimately society as a whole has to decide how much of their resources should be used on improving social equity in the delivery and uptake of services.

Public health implications

- Childhood immunisation is an effective health care activity, and upake should therefore be high and equal between social groups
- We examined whether an intervention to improve overall immunisation uptake also reduced social inequalities in uptake
- Despite a substantial improvement in overall uptake, social inequalities in uptake remained unchanged or became wider
- Only when uptake in the most affluent groups approached 95% did social inequalities begin to narrow
- Indiscriminate population based interventions to improve other aspects of health may likewise fail to reduce social inequalities in those aspects of health

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